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THE GENESIS AND DEVELOPMENT OF HUMAN INSTINCTS.

By L. C. WOOSTEE, Ph. D., State Normal School, Emporia.

Read before the Academy, at Topeka, December 30, 1904.

INSTINCT has been defined as the ability possessed by an animal or plant to perform, without foresight of the ends, those acts by which the development and preservation of the individual or species is secured. It is an inherited tendency or a racial instinct-memory that causes each plant and animal to do blindly all things needful for the growth and security of the organism.

Above and beyond those activities which are instinctive are those which are characteristic of the individual and are performed under the direction of the will. The organism is fully conscious of these activities and of the ends to be attained by them.

Between those bodily movements and mental processes which are performed instinctively and those which are done consciously is a connecting set of activities, part of which have become habitual from conscious repetition, and part are racial tendencies which induce subconscious activities. The habits of body and of mind lie in the nearer borderland of conscious activities and are established by a conscious repetition of a bodily movement or a mental process. Farther out on the fringe of consciousness are the inherited, semiinstinctive tendencies to activity which have for centuries been a puzzle to the philosophers and have but recently yielded some of their secrets to the psychologists. These are the subconscious or subliminal activities which are exhibited in panics or stampedes of people and horses, of mob violence induced by suggestion, in the frenzy for collecting strange and rare things shown by crows, magpies, and naturalists, and in a host of uncanny manifestations of the subliminal self in trances and hypnotic states.

There is no question but what conscious activities repeated many times become unconscious activities or habits; but there is a hesitancy on the part of many to take the next step, and believe that habits persisted in by many generations of individuals become inherited, subconscious activities, and that these in time are established as instincts.

In my opinion this hesitancy arises from an incorrect method of study of the question, in a failure to grasp the full significance of the theory of evolution in its applicability to all phases of plant and animal life, and in neglecting the most important factor of all life, and its possibilities.

All who are interested in this problem will at least agree that all the activities of the mind, of the body as a whole, of each organ and tissue, and of each protoplasmic cell may be grouped under one or the other of a connected series of heads:

1. Conscious activities.
2. Habits.
3. Subconscious activities.
4. Instincts.

The attitude of the evolutionist towards a consistent theory of development of these four forms of activity and the exceeding importance of the life factor in them all will receive due attention in the course of this discussion; but the proper method to be employed in studying any problem in which life is the chief factor demands immediate consideration.

The methods that have been employed in the solution of biological problems are two in number, the mathematical method and the life method.

The mathematician is concerned with the investigation of the logical consequences of certain exactly statable postulates or hypotheses. The method of the mathematician may be used with the greatest propriety in all investigations in chemistry, physics, engineering, and dynamical geology, for the factors in these subjects obey physical laws and each cause is followed by its logical effect.

In biology, on the contrary, the one who uses the method of the mathematician can meet only with wrong results, for life obeys no law other than its own highest good, and this cannot be stated in mathematically exact terms. Life observes physical laws so far as it is needful to do so to attain to its own best success in the struggle for existence on earth and no further, and, therefore, where life intervenes, causes are not followed by their full, logical effects.

Doctor Loeb, in his theory of tropism, says that an organism when unequally stimulated is caused by the stimulus to so orient itself that its parts are equally stimulated. He seems to mean that an organism orients itself just as does the magnetic needle when under the influence of a parallel current of electricity.

Doctor Jennings, of Pennsylvania University, has demonstrated in a remarkable series of experiments that the *amœba*, for example, does not orient itself in accordance with the theory of tropism. In these experiments Doctor Jennings found that the *amœba* invariably moves in accordance with an influence exerted from within, that trial and failure are important factors in determining what it will do. The external cause was not followed by its logical effect, for life intervened and determined for itself the direction of motion.

Doctor Hibben, of Princeton, says, in his "Problems of Philosophy,"

that there is present in every organism a self which preserves its identity through all the successive stages of progressive psychical experience, and acts as a unifying principle in coordinating all the several stages of development within the sphere of permanent personality.

All in every-day experience agree that it is futile to attempt to express life values in terms of mathematical units. No one would try to sell ideas to the publishers by the pound, nor to express the skill of an engineer by the yard unit, nor to extract the cube root of a theory in science. Then why should a biologist attempt to establish a physical explanation for tropism, as does Doctor Loeb, a mathematical basis for heredity, as did Doctor Weismann and his followers in their germ-plasm theory, or make heredity a problem in physics, as did Mendel and DeVries in their manipulation of chromosomes in the egg and sperm?

I maintain that the only method a biologist should use in studying life processes is one that harmonizes with the method used by life itself in developing its higher powers in the individual and in the race. This life method has been studied by biologists along four different lines of research; and the fact that these four lines of study, pursued in fields so widely diverse, harmonize in their results so perfectly, is one of the chief arguments for the validity of the method.

Four submethods for studying the plant and animal kingdoms are:

1. That of the systematic botanist and zoologist.
2. That of the evolutionist.
3. That of the embryologist (ontogeny).
4. That of the paleontologist (phylogeny).

The biologist has long known that plants and animals may be grouped in a tree-like ascending series, made up of branches, classes, orders, genera, and species. This work of the systematist serves as a standard of comparison in ranking activities.

The evolutionist holds, as a basic principle of his theory, that life has always had a general upward tendency, and consequently the later and higher organisms and processes have been evolved from earlier and lower organisms and processes.

The embryologist has learned that the life of each higher organism, in the course of its development from the egg, repeats in a general way the history of its race. This discovery evidently harmonizes with the theory of evolution.

The paleontologist, in arranging the fossil life forms in their chronological sequence, has found that the lower forms of life of the systematist appeared on earth first, and that the higher forms appeared successively later.

The systematic biologist, the evolutionist, the embryologist and the paleontologist agree in concluding that life on earth, in its mode of

development, proceeded from the simple to the complex, from the undifferentiated to the differentiated, and from the unpleasant to the better. I would add as a probable hypothesis, in harmony with the preceding, that in the development of the race conscious activities preceded the habitual, the habitual preceded the subconscious, and the subconscious the instinctive activities. By heredity the individual acquires in the beginning a large store of instinctive tendencies; later the subconscious activities appear; and finally, when independent existence is reached, the conscious and habitual activities give the possessor freedom in his environment.

No attempt will be made to prove this hypothesis by a course of logical reasoning, for life is a variable factor, and the syllogism does not apply in the life method. A few illustrative examples will be taken here and there merely to show the general harmony of the hypothesis with life methods.

The mammalian egg, when fertilized by a sperm cell, begins at once the work of segmentation, and the cells divide and subdivide till sixteen or thirty-two cells are produced, arranged in the form of a sphere.

This process of segmentation of the mammalian egg is entirely instinctive, for it takes place blindly, after a fixed plan. It divides first into two cells; these two cells subdivide by a plane at right angles to the first plane, forming four cells; then these four cells subdivide by planes at right angles to the other two planes and eight cells result. This regular order of division planes is one of the distinguishing differences between complex plants and animals. In all complex plants the second, third and fourth planes are essentially parallel with the first plane, and greatly elongated forms result.

In the segmenting mammalian egg the first eight cells are arranged roughly in the form of a cube; then, as the segmentation continues, a solid sphere is produced, the morula; next a hollow sphere, the blastula; and then, by a process of unequal cell growth and invagination of the blastula, a hollow cup is formed, the gastrula.

We shall possibly find the nearest analogues of the mammalian egg among the mouthless mastigophora. Ninety-nine one-hundredths of the protozoa are provided with mouths, or have no cell-walls, or have very thin places in their cell-walls for the ingestion of solid food. A mouth or its equivalent gives its possessor such an advantage in the struggle for protozoan existence that its fortunate or, better, unfortunate possessor lacks strong incentives for developing a structurally more complex type of existence.

The mouthless one-celled organism must live all his days as a plant by absorbing carbon dioxide, water, and certain mineral salts, and from these prepare starch, sugar, and proteids, or he may get part of his nutriment this way and prepare digestive ferments, as do his

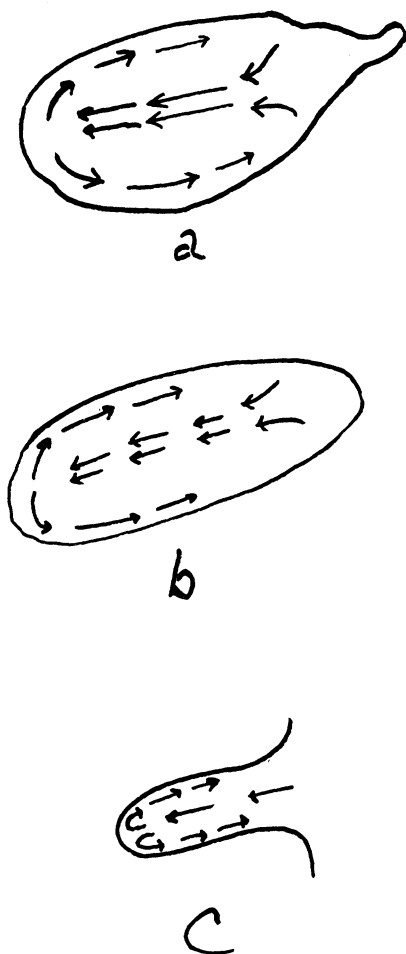


FIGURE 12.

Figure 12 shows the direction of currents in the Amoeba required by the tropism theory and claimed to have been seen by Bütschli and Rhumbler.

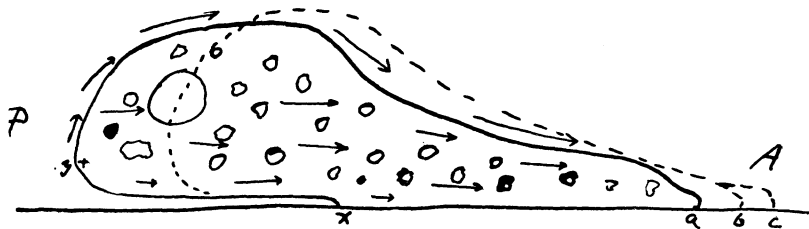


FIGURE 13.

Figure 13 shows the direction of currents reported to have been seen in the Amoeba by Jennings. The figures are taken from an article by Doctor Jennings in *The American Naturalist* for September, 1904. A criticism of Doctor Jennings's book, "Contributions to the Study of the Behavior of Lower Organisms," by Doctor Yerkes, of Harvard, may be found in *Science* for December 2, 1904.

fellows with mouths, and excrete them, so as to dissolve solid food which may have been captured by his flagellum. This is the condition of our mouthless mastigophore. He digests and absorbs just enough solid food, we may believe, to serve as a proper stimulus to get more; and this stimulus, we may imagine, led some ancient mastigophora to form solid spheres, the morulæ, or hollow spheres, the blastulæ, or double-walled cups, the gastrulæ. Fairly good examples of these we find in the eudorina and pandorina, which stop development at the solid sphere and then begin conscious activity; in the volvox, which develops till it becomes a hollow sphere and then takes upon itself full conscious activity; and in the fresh-water hydra, which develops from the fertilized egg, passing through the morula and blastula stages and reaches the gastrula stage, where it takes to itself all the conscious activities of an independent organism.

If it is hard to believe that these simple organisms may form habits, be subconsciously active, and have these modes of activity finally established as instincts, we should recall some of the wonderful things learned about the bacteria, those tiny, one-celled plants which divide and subdivide so as to form new generations every few hours, and are much simpler in many ways than the mastigophora and yet much like them in being provided with flagella.

It has long been known that, among the pathogenic bacteria, the same species may at one time be exceedingly virulent, and, at other times, be mild and even almost innocuous.

It has lately been discovered that the nitrogen-fixing bacteria bury their instincts beneath new habits with the greatest ease. Doctor Nobbe, an eminent German bacteriologist, conceived that it would be possible to make a fortune selling nitrogen-fixing bacteria to the farmers, so he prepared cultures of these bacteria to sell at a dollar a bottle. Doctor Nobbe's "nitragin," as he called it, was worthless, for he had so satiated the bacteria with rich, nitrogenous foods that they had lost their desire and, indeed, their ability, to use free nitrogen. It remained for an American, Dr. Geo. T. Moore, to discover this fact and to devise a way by which our department of agriculture could supply to the American farmer, at a cost of only a few cents a cake, nitrogen-fixing bacteria that are so hungry for atmospheric nitrogen that they are doubly efficient.

Of higher mold than the hydra, the mammalian embryo does not stop at the gastrula stage of growth, but, by cell multiplication and differentiation and a series of secondary and tertiary invaginations and a few evaginations, it next develops the tissues, organs and cavities which characterize the adult animal. To the time of independence of the mother, these activities are all instinctively performed; but

from this time forward some are instinctive, some are subconsciously done, some are the result of habits, and most are consciously guided and controlled by the will.

Among those animals which reach stages of complexity higher than the gastrula, but come short of the complexity attained by civilized man, some enter the conscious stage of development as worms and remain such all their lives; others become fish; others are conscious first as tadpoles and go a step farther and become frogs; some, possibly, are marsupials; some are herbivores or carnivores; some are apes, and some are barbarian bipeds.

The embryo of man forms in its development peculiar structures which show various places where instincts became buried. At one stage it exhibits gill slits and a well-developed tail; later it cannot be distinguished from the embryo of a fellow mammal; and even in adult life man carries in his body dozens of structures, inside and out, which are no longer functional or consciously used by him.

In the mind are various functions not so deeply buried beneath later acquisitions of race experience. Some are of service in food-getting, others are useful in defense, and others, as do rudders to ships, serve to guide the wavering mind to a safe harbor. The presence of these inherited race tendencies, serving as promptings from the subconscious self to conscious activity, may have led Plato to suppose a previous, personal existence of the human soul, may have caused Buddha to teach the possibility of soul transmigration, and may have caused Kant, who had only faint glimmerings of the doctrine of evolution and of the transmission of the wisdom of the race through heredity, to maintain that man knows many things *a priori*—that is, previous to individual experience.

In conclusion, I merely repeat what I have maintained in this paper, that heredity, instinct, subconscious promptings, habits and conscious activity are all related problems of life, not of matter, force, or energy, and are incapable of solution except by using the method taken by life in solving the problems of its own existence on earth. Following this method, we must conclude that the first activities of life were consciously performed, and that in the course of the ages these became in turn habits, subconscious activities, and then instincts. This is true of all life, including man, the king of creation.